

Temporary Structure with Gates Closed

Protection will be provided by June 1, 2006, using an interim closure structure with temporary pumping.



Pump Station No. 6

Picture looking north down 17th Street Canal to Lake Pontchartrain. There are 12.6 miles of floodwall in the parallel protection systems along the three Orleans Parish outfall canals. Floodwalls breached in two of the three outfall canals and undetermined sections of un-breached floodwalls may be weakened.



Outfall Canal Closures

The addition of tree sets of gates and pump stations at the canal outfalls on the Lake Pontchartrain lakefront will remove approximately 12.6 miles of floodwalls from the primary Hurricane Protection System. These gates will become secondary aspects of the system. Long-term protection can be met with a permanent pumping station at the lake side end of each of the three outfall canals, removing

Improvements to New Orleans' Hurricane Protection System

On low ground, surrounded by water on all sides, New Orleans depends on an ever-evolving, man-made system to protect it from floods, hurricanes and storms.

Pump stations, some a century old, move water from city streets into a series of canals that ultimately lead to Lake Pontchartrain.

Three major outfall canals drain water from the center of the city north to the lake. More than 14 miles of levees and floodwalls bordering these canals form part of the region's Hurricane Protection System.

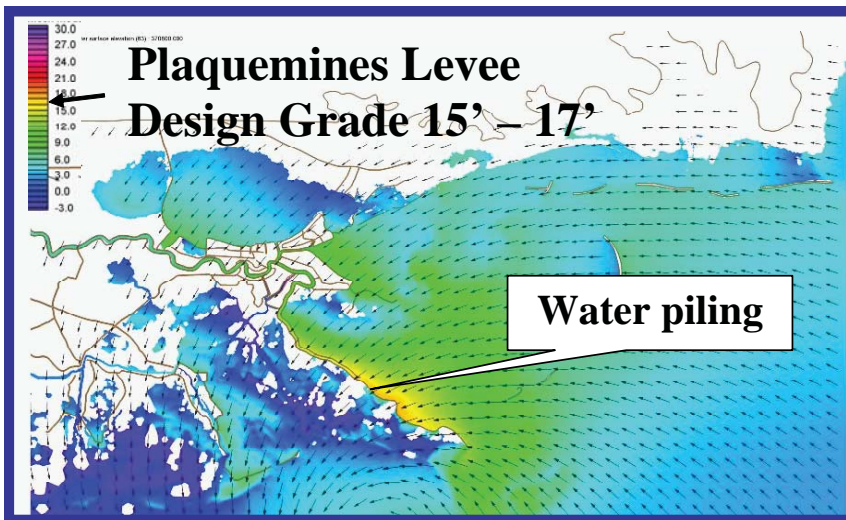
The 17th Street Canal, the Orleans Avenue Canal and the London Avenue Canal proved vulnerable to Hurricane Katrina's massive storm surge.

Adding a structure at the mouth of each canal is key to better protection. These new structures will keep storm surge out and permit existing pump stations to continue operation.

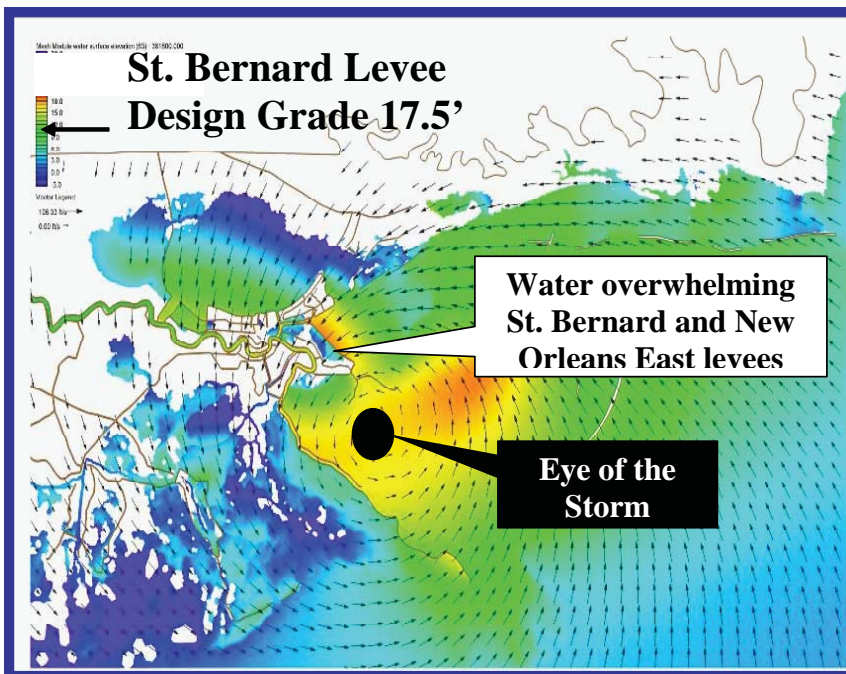
The Inner Harbor Navigation Canal (IHNC), reliant on floodwalls and levees on the east and west banks to prevent storm surge from entering populated areas, also proved to be vulnerable to Katrina. Two proposed navigable floodgates would keep storm surge waters from Lake Pontchartrain to the north and Lake Borgne to the east out of the Industrial Canal area.

Additional proposed measures would also increase regional hurricane protection. These proposed measures would raise and armor portions of area levees and restore southeast Louisiana's

the need for floodwalls from the primary Hurricane Protection System. Permanent pump stations are the most cost-effective solution. Under normal conditions, the floodgates will remain open and the canals will drain by gravity flow. When lake levels rise during tropical storm events, the flood gates will close and canals will be drained using permanent pumping capacity.



Hours 1 --- 4 a.m. on August 29, 2005. Model tracks Katrina as it moves across New Orleans.



Hours 4 --- 8 a.m. on August 29, 2005. Three hours after landfall.

vast system of wetlands, marshes and natural ridges. These measures would also include steps to ensure pump stations can operate during and after storms.

The U. S. Army Corps of Engineers and the Interagency Performance Evaluation Task Force are using state-of-the-art tools to improve understanding of major hurricanes and provide a better, stronger Hurricane Protection System.

One such tool is a model that shows the storm surge Hurricane Katrina generated as the eye passed just to the east of New Orleans.

These various tools will enable the Corps to enhance the current Hurricane Protection System in several ways.

The three outfall canals that drain water from portions of the city north into Lake Pontchartrain are critical elements of the New Orleans' flood control system. Pump stations move water from lower elevations in protected areas into canals that drain into the lake.

Immediately after the hurricane, the Corps of Engineers installed sheet pilings as emergency closures to keep

surge from entering the canals and re-flooding the city. The Corps will also install interim gates and temporary pumps by June 1, 2006, in time for the next hurricane season.

When Katrina's surge waters flowed into the canals from Lake Pontchartrain, portions of New Orleans flooded.

To prevent this in the future, the Corps of Engineers has proposed placing permanent gated structures and pump stations at the mouths of the three outfall canals as part of the Hurricane Protection System.

When surge is imminent, operators will lower the gates and turn on their pumps to allow drainage to flow while preventing surge from entering the canals. When the surge recedes, they will reopen the gates and resume normal drainage.

Navigation Canal Floodgates

During hurricanes, surge waters can enter New Orleans' Industrial Canal (IHNC) area from the east and from Lake Pontchartrain to the north.

A currently proposed pair of navigable floodgates would close when hurricanes threaten. By preventing storm surge from entering the Industrial Canal (IHNC), these gates would protect a vital residential and commercial area.



GIWW/MRGO Floodgate

Hurricane Katrina severely damaged portions of the I-walls along the IHNC and the GIWW. The existing canal walls must either be replaced with T-walls or the entire canal system must be protected from storm surge by adding navigable flood control structures.

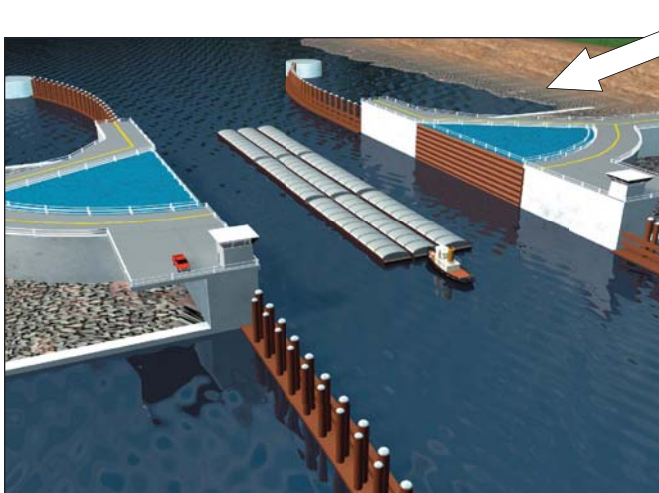
The smaller of the two gates, at the Seabrook entrance to Lake Pontchartrain, would permit barge traffic to pass.

Katrina's storm surge overtopped floodwalls in this area, causing significant flooding to Orleans Parish to the west, New Orleans East and the Lower Ninth Ward.

In addition to protecting lives, these navigable floodgates would reinforce the protection provided by the existing 20 miles of levees and more than seven miles of floodwalls. Although the placement of the second larger navigable floodgate is not precisely determined, it is proposed to be near the intersection of the Gulf Intracoastal Waterway (GIWW) and the Mississippi River Gulf Outlet (MRGO) where it would tie into the existing levee system.

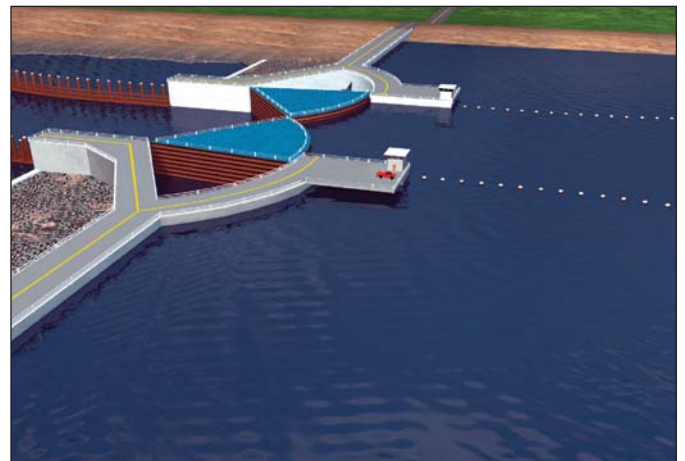
Large enough to accommodate deep-draft vessels using these waterways, this structure would be a key component in the defense against storm surge approaching from Lake Borgne.

The combination of these two new floodgates with the existing IHNC lock would protect the New Orleans inner harbor area from hurricane storm surge.



GIWW Structure Open for Navigation

Sector gates will remain open to allow normal navigational traffic along the GIWW and the MRGO. A smaller navigable flood control structure at Seabrook will allow traffic to pass between Lake Pontchartrain and the IHNC. These structures will be closed only during storm events. (Arrow points to the movable sector gates.)



GIWW Structure Closed for Flood Control

When water levels rise during tropical storm events, the flood (sector) gates will close and prevent storm surge from entering the protected areas.

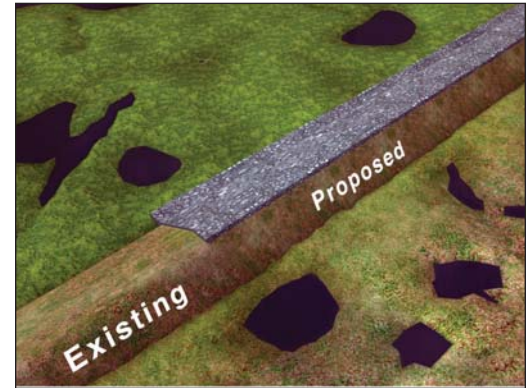
Selective Armoring

Storm surges can overtop levees. When this happens, the backside of those levees can erode and scour, allowing breaching and, thus, flood damage.

Most southeast Louisiana levees are made of appropriate soils with no stone or concrete armoring. They are strong enough to resist storm surge but become vulnerable when overtopped.

The Corps has proposed armoring the backsides of levees in the areas most exposed to storm surges and the base of floodwalls to protect them from erosion when overtopped.

The Corps would also armor some of the transition points between levees, floodwalls and other structures that had proved vulnerable during Katrina.



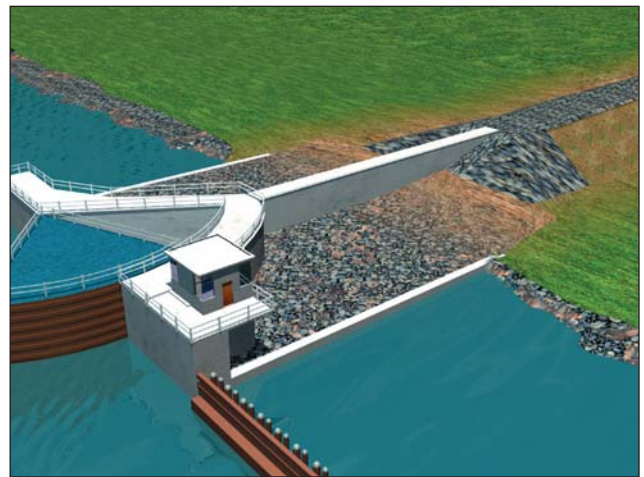
Armoring

Levees and floodwalls will be armored at areas most exposed to surge damage, at transitions between levees and floodwalls, and at other critical points.



Failure at Transition Point

Storm surge overtopped the protection system in many places causing major damage and/or complete loss of significant sections of levees. (Armoring at transitions will limit damage to the protection the system offers and reduce inflow of floodwaters.)



Armor Transitions

Additional stone and concrete armoring will be added at transition points between structures, floodwalls and levees.



Levees Damaged by Storm Surge

When water overtops levees and flows around transitions, it erodes the back-sides of levees, which reduces the cross section and weakens the levee.



Levee and Transition Armoring

Armoring of the backsides of the levees and at transitions between floodwalls and levees protects them from erosion.

Storm Proofing Pump Stations

Dozens of pump stations critical to prevent flooding from rainfall within the flood protection system are scattered throughout the New Orleans metropolitan area. The largest of these is capable of pumping 10,000 cubic feet of water per second. Most pump much less.



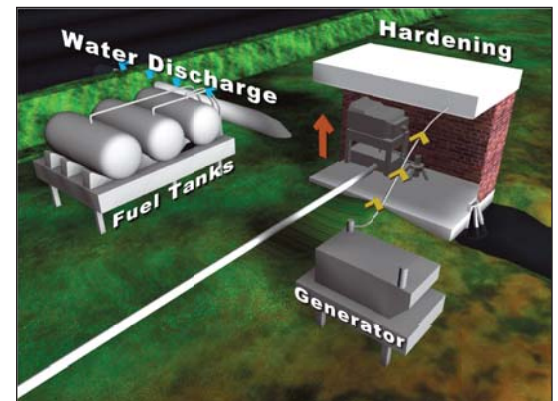
Inundated Pump Station

Pump stations were inundated with flood water and unavailable for immediate dewatering operations. Pump stations remain vulnerable in the event of a severe rainstorm, loss of power or the overtopping of levees and floodwalls resulting from storm surges greater than design level.

Built at various times over the past century, many of these stations are vulnerable if floodwaters rise faster than the station's capacity to pump. In fact, during and immediately after Katrina, most of these pump stations were forced to shut down for one reason or

another. Some had critical equipment flooded. Others lost external power supply. Some did not have adequate protection for their operators.

The proposed work will add site-specific enhancements to these pumping stations. The stations will be more reliable during future storms because of improvements that provide back-up power, fuel sources, raised equipment and overall structural hardening.



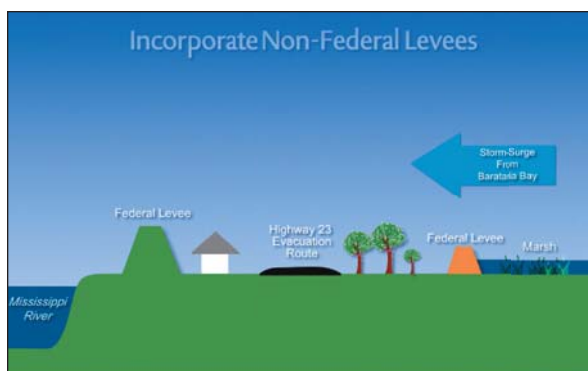
Pump Station with Stormproofing Improvements

Improvements will vary significantly from station to station but may include hardening of the structure, addition of emergency generators and fuel supplies, and critical equipment. Pump stations used to discharge rain, seepage, and storm surge overtopping, will be hardened to meet current construction criteria, will have critical equipment raised, and will have emergency power and fuel systems added.

Incorporate non-federal levees

A federally constructed system protects the majority of the west bank of Plaquemines Parish on the Mississippi River south of New Orleans.

However, flooding can block the only evacuation route from the south, Highway 23, a critical 23-mile segment between Jesuits' Bend and Port Sulphur with no federal levee



Storm surge from Barataria Bay can overtop non-federal levees and cut off Highway 23, the only evacuation route out of southern Plaquemines Parish.

on its gulf side.

A non-federal levee pro-

jects this agricultural area from frequent, low-level storm

surges coming from the west through the Barataria basin. But the area has subsided and the critical wetlands have degraded allowing flooding to occur more frequently.

The proposed plan will heighten, strengthen and incorporate these non-federal levees into the federal system to protect and safeguard this vital evacuation route.



Non-federal levees in Plaquemines Parish will be incorporated into the federal levee system, raised and strengthened.

Ecosystem Restoration

Coastal Louisiana's rich ecosystem has historically reduced the impacts of storm surge. Barrier islands, marshes and natural ridges all contribute to this protection.

However, subsidence, saltwater intrusion, rising sea levels and lack of new sediment have all degraded the coastal ecosystem. This damage has lessened the system's ability to impede the early rise of water into natural basins.

Water levels can rise days in advance of a hurricane's arrival, filling natural basins such as Lake Borgne and Lake Pontchartrain. When the main storm surge hits, the already heightened water levels rise even more.

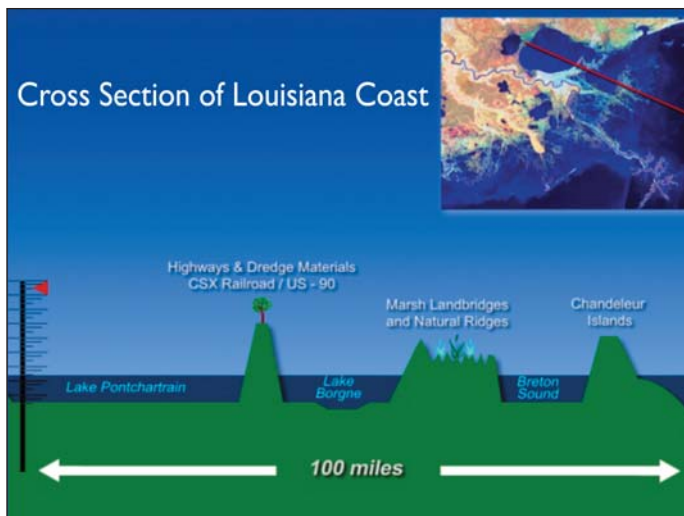
The proposed plan will reverse wetland losses in areas affected by navigation channels, oil and gas channels, or other channels and modify the Caernarvon Freshwater Diversion structure or its operation.

These enhancements will help lessen the early flow of storm water into Lake Borgne and Lake Pontchartrain. When the main surge arrives, the basins can then hold more floodwater, thus reducing high water and potential flooding.



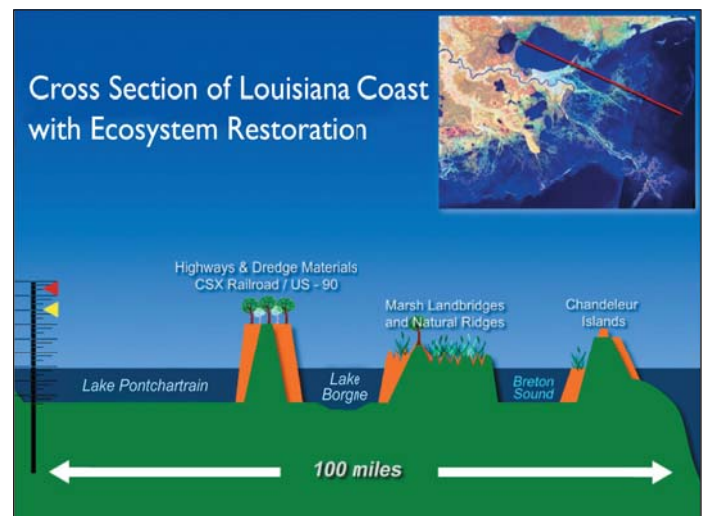
Lines of Defense

There are natural lines of defense against tropical storm events within a healthy ecosystem. These include barrier islands, marshes, natural distributary ridges and land bridges between lakes and bays. The presence of these natural features helps to reduce storm surge.



Degraded Lines of Defense

The degradation and/or loss of barrier islands, natural ridges, and marshes allows for a more rapid filling of the water storage areas during the initial stages of tropical storm events.



Enhanced Lines of Defense

While the wetlands do not prevent the large surge immediately ahead of landfall, they do reduce the initial inflow several days ahead of landfall. This provides storage capacity to mitigate the height of the surge in Lake Pontchartrain.